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THE ROLE OF ENERGY CONSERVATION IN A NATIONAL ENERGY POLICY

*By Joseph C. Swidler**

In this quadrennial season of political acrimony, at a time of divisions and controversy at home and of hot and cold running wars abroad, it is pleasant to know that Americans are united on at least one fundamental question. All are agreed that this country needs a national energy policy. The coal industry, the oil producers, the utilities, the manufacturers of electrical equipment and the consumer organizations have reached a happy consensus on this one point. Of course, they disagree violently on what such a policy should be, and how it should be administered. Still, let us take comfort from any kind of consensus in this period when it is difficult to get agreement on anything.

This country had no need for an energy policy ten years ago; or rather, most people did not recognize the need for one until late in the last decade. What drove us to a recognition of the need to think about energy was primarily the emergence of shortages—too little gas to meet demands, a growing dependence on oil imports, spreading power brownouts, and other signs that all was not well in the energy industries. Shortages, in turn, are a reflection of the problems associated with growth, not only in energy use but in overall productivity. An energy policy, when it emerges, will turn out to be a growth policy as well.

Thomas Malthus, in 1798, in *An Essay on the Principle of Population,* provided the first systematic study of growth, focusing on the disparity in growth rates of people and subsistence. He concluded that population tended to grow at a geometric rate and subsistence on a linear basis, so that only famine, wars and disease could bring the two into periodic balance. He proved to be right about population growth—thus far—and wrong—thus far—in growth in subsistence levels, where technological changes have, on

the whole, kept pace with population. While world population burgeoned, the Western world at least has enjoyed an unparalleled affluence, and the Malthusian voices were stilled. But now a whole school of neo-Malthusians has come forward. They remind us that exponential growth cannot continue forever, and they foresee early trouble if the pace of growth is not slowed.

The figures on growth in the last century are indeed impressive. In the period 1870–1970, the population of this country grew more than five-fold, from 40 million people to over 200 million. Energy use grew three times as fast as population, by about 1600%, reflecting in part that the last century has encompassed the age of electricity and that a constantly increasing share of primary fuels are converted to that form. Not only does electricity account for the direct burning of about 25 percent of the nation's fuels, but it has made possible new industries, new products and new appetites for goods and services which have generally inflated requirements for fuels as well as other products and services.

A variety of growth impact studies have recently been reported, based on varying proportions of emotion, special interest, preconceptions and objective analysis. One of the most significant developments has been the use of computers for these studies. The reports on the studies made at Massachusetts Institute of Technology, under the sponsorship of the Club of Rome, based on extensive computer models, are now well-known. They are reported in two recent books, Professor Jay Forrester's *World Dynamics*, and *The Limits to Growth*, by Dr. Dennis L. Meadows and other members of an MIT research team. These volumes picture a world in which growth in productivity is outpacing available resources, and in which the land available for agriculture declines year by year as growth in population diverts land resources from agricultural use to housing, highways and other non-agricultural purposes.

The authors of these studies hedge their conclusions by conceding that the models have yet to be perfected. Some critics go further and say that the studies are basically flawed, for much the same reason that the Malthusian projection is faulty, in that they fail to take adequate account of the pace of technological change. At any rate, the concern in this country with the problems of growth has become pervasive if not obsessive, and to a degree it is supported by common experience and by observation of the world around us. The effects of crowding are visible everywhere. Many parts of the world are already unable to feed their people. Clearly,

there are limits to the capacity of surface waters to absorb pollution. The world atmosphere may have limits so large as not to be a controlling factor, but in the densely populated parts of the world air pollution conditions are already troublesome. A large share of the world's original store of petroleum resources has been subjected to combustion in the interests of industrialized society, and the remainder is going very fast. While coal is in reasonably large supply in this country, the environmental impact of coal mining, transportation, and use pose difficult problems in a society intent on improving the quality of the environment.

It is not necessary to join the forecasters of early doom to reach the conclusion that it is wise for society to slow the pace of growth and to accelerate the pace of technological improvement if we are to avoid severe problems of adjustment in a world of diminishing resources. Perhaps technology unaided by measures of prudence or restraint can avoid ultimate disaster, but to put unlimited faith in that proposition is a gamble mankind cannot afford. Certainly technology cannot restore spaciousness in a world more heavily peopled from year to year, and ever more crowded with the artifacts of man. The need for social restraints on growth is an idea whose time has come.

In particular, I shall deal with restraints on growth in energy use because of the functional relationship between energy use and general productivity. Restraining growth in energy use clearly will have an impact on overall productivity, just as accelerating energy production encourages general growth.

I realize that economic growth is essential to meeting the social problems of our society, particularly poverty and unemployment. I do not advocate a no-growth policy. Rather, I favor a gradual tapering off of the rate of growth, to be achieved by curbing waste and marginal social satisfactions, to the extent possible within a free economic framework, and the development of patterns of growth which puts heavier emphasis on the quality of life rather than the quantity of possessions.

Oak Ridge, a world-celebrated community of outstanding scientists with historic production achievements, has made giant contributions to the uses of the atom for civilian power production, as well as for military purposes. A great deal of work is now being carried out in Oak Ridge for the improvement of the present generation of nuclear reactors, the development of the breeder, and the ultimate transition to fusion power. The vision beckons

of a day when energy can be produced in virtually unlimited quantities, at low cost, and without harm to the environment, and when the energy of the atom will make available an almost inexhaustible supply of essential materials. Some, intrigued by this vision, might question whether there is need for energy conservation programs, and perhaps whether our efforts might not be better employed in finding more ways to use energy to improve man's lot.

Our positions are not wholly irreconcilable. A part of this vision I can share. I am confident that in the next decade we shall see breeder technology applied successfully on a commercial scale, and I am stirred to hope by the slow but constant progress in solving the difficulties that stand in the way of civilian fusion reactors. Nevertheless, experience indicates that every pioneering development in energy production will entail substantial social costs and risks. After two decades of development, residual questions remain with respect to the safety of the current generation of nuclear stations. Clearly we need far more research on safety and environmental impacts, and until it is completed the only sensible policy for this country is one of diversification in generating sources. It is far safer to base an energy and growth policy on reasonably available technology than to stake everything on the perfectibility of the world through future scientific developments.

Let me say a prosaic word about our present energy posture. The widespread controversies in licensing proceedings over the environmental impact of nuclear power plants have delayed construction of most plants to such an extent that diversification of power sources is not an option but a necessity, and one that is costly in terms of use of hydrocarbon resources, particularly oil. Studies by the staff of the New York State Public Service Commission indicate an oil demand in 1980 of over 28 million barrels a day (MMBD) as compared with 14.7 MMBD in 1970. A good deal of the increase is required for power generation because of delays in construction of nuclear stations and the difficulty with available technology of using this nation's coal resources in a manner compatible with the new restrictions on air pollution. All of the increase in oil requirements must come from imports, and most of the growth in imports can come only from the Middle East and North Africa. Imports in 1980 will probably reach 16.5 MMBD, which would amount to 58 percent of national oil requirements and 38 percent of total energy needs. The imports from the Mideast and North Africa alone would be about 70 percent of total imports,

or some 40 percent of total oil requirements and more than a quarter of total United States' energy demands in 1980.

It is evident that dependence on imports to such a degree, and especially from politically unstable areas of the world, poses a threat to national security. Interruptions and threats of interruption of oil supplies could profoundly influence American life, including the ability of this country to continue to stand for the libertarian principles which give this country its special character as a nation. It seems to me that we dare not ignore this threat to the safety of the United States and the vitality of American principles, in reliance on new energy technologies which have yet to be proven and whose environmental side effects are still unknown, especially since they cannot possibly come into use for many years. In the meantime this country's energy position will be precarious.

Before making a few suggestions for energy conservation, I should like to take up some other proposals along this line which are frequently heard. One is to curtail power use by the elimination of "frivolous" electrical appliances; another is to achieve the same goal by inverting the rate structure for electricity. I doubt that either of these proposals will be of much help in conserving energy, for reasons I shall discuss briefly before proceeding to my own suggestions.

One difficulty with the elimination of "frivolous appliances" is suggested by the term itself. There may be a few people who would be willing to purchase and operate a heavy power-using appliance which would not contribute substantially to their comfort or enjoyment, but the market would not be large. I know of no appliance in widespread use which could fairly be considered frivolous and which is a heavy consumer of electricity. Most of the appliances held up as objects of frivolity use five or ten kilowatt hours a year, something like one-tenth of one percent of average residential use. The appliances most frequently mentioned in this context—the electric toothbrush, carving knife and can opener—fall in this category. Their purchase may be thought to involve a waste of money and material resources, but their total elimination would have an imperceptible effect on the curve of national power use.

Considering the impossibility of establishing a consensus on what constitutes a frivolous appliance, the extremely difficult problems involved in attempting to regulate or prohibit the production, sale and use of such appliances, and their infinitestimal

contribution to the problems of energy supply, it seems doubtful that it is profitable to pursue this idea further. It suffices to say that no one should purchase or use any electric appliance, or anything else, for that matter, that he does not want or need.

The proposal for inverting the electric rate structure stands on another footing. It is a proposal that has been made by a number of thoughtful people. Electric rates are fixed by public authority, and if the proposal has merit it could be implemented by existing administrative agencies (although not without difficulty) either under existing laws, or with the benefit of additional legislative direction. The question of the applicability of this concept, therefore, warrants careful study.

At the outset let me distinguish the regressive rate proposal from proposals to eliminate promotional rates. It was common in the past (and is only a little less so today) for power enterprises, public and private, to sell electricity on a block or step basis in which the ultimate block or step carried a kilowatt hour rate which barely covered incremental energy costs. The theory was that in order to get to the last step a consumer would need to pass through the prior and more profitable steps, and that even small incremental earnings for the final increment of kilowatt hours contributed a little to profit. Undoubtedly, some of these rates involved considerations other than those strictly of cost. In the Tennessee Valley a prime consideration was improvement in the standard of living by making available abundant amounts of energy at very low prices. In other areas the power companies were waging a battle with the gas companies and the oil dealers for space heating and other loads, and the competitive atmosphere may well have induced some shading of cost estimates. The power companies were in a competiton of excellence among themselves, and one of the tests was rate of growth. Some companies may have thought it was worthwhile attaching the incremental loads even on a breakeven basis because they constituted a reservoir of business volume which could be made profitable by rate increases at a later time. Competition for new industrial plants also played a role in driving down the follow-on rates. Whatever the reasons, many companies offered inducements for increased use which went beyond those which could reasonably be justified even on an incremental cost basis, giving consideration to demand as well as energy costs.

I agree entirely with the view that under present conditions there is no need or excuse for promotional rates. The New York

State Public Service Commission is dealing vigorously with this problem. We are requiring that the follow-on rates be increased to the point where they bear a fair share of demand as well as energy costs and make a reasonable contribution to earnings requirements. In addition, the Commission has rejected most promotion expenses as allowable elements of cost in rate cases, and the utilities in New York are in the process of a wholesale dismantling of their promotion staffs.

The inversion of rates is a different matter. It does not contemplate improving the relationship of the prices of the various energy or demand blocks to costs, but rather the deliberate pricing of follow-on blocks substantially above costs and above the prices for the early blocks in order to deter usage. Rather than being based on costing refinements, it involves the subordination or abandonment of cost as a basis for pricing, and of price as an allocator of resources on an efficiency basis.

Such a pricing basis is ill suited to the electric power industry. This industry is the classic example of the benefits of the economies of scale. Large generators are much cheaper per unit of capacity than small ones. The same is true of transformers. With respect to transmission lines the rule of thumb is that the costs tend to increase arithmetically while line capacity increases geometrically. Indeed, it is just these economies of scale which have made it possible for the utilities for several decades to offset a creeping inflation and reduce power costs while most other prices advanced year by year.

The refusal to recognize these crucial cost factors in pricing would create more problems than it would solve. For example, industries which could capture the cost savings from economies of scale with their own equipment would install their own generation whenever the costs were below the arbitrary central station prices. Since the individual generating units would be more costly and less efficient than the larger utility equipment, the result would be a mis-allocation of resources. If the proposal were implemented on a state-by-state basis the result would only be to drive industry and employment from one state to another. It is hard to visualize the federal government imposing national uniformity, if for no other reason than the doubtful justification of inverted pricing. All in all, inverted pricing seems both ineffectual and impractical as applied to industrial loads.

The situation is not much better as applied to residential usage.

The Office of Economic Research of the New York State Public Service Commission has under way an intensive study of the inverted rate proposal, and has completed the study as it relates to residential use. The conclusion of the study is that the elasticity of demand for electricity for residential use at rates close to historic or prevailing levels is likely to be negligible both in the shortrun and in the longer term, because the proportion of the consumer budget spent on electricity is too low to make it readily responsive to price changes. At sharply higher rates, perhaps double or triple the present schedules, the rate of growth might be dampened, but declines from existing levels of consumption are not to be expected even on the basis of such extreme rate action. Consumers are not likely to put into effect major reductions in the operation of current appliance inventories or to convert quickly to other energy sources. On the other hand, growth in population and income will continue to exert upward pressures on demand. The real determinant of power use is the proportion of single-family housing.

A proposal of potential importance is to find a way to encourage the use of materials involving low energy input in substitution for materials requiring large volumes of energy for their production. Examples are the use of steel rather than aluminum containers for beer and other beverages, of paper rather than plastic for wrappings and containers, of natural rather than synthetic rubber for many applications, and of cotton, wool and other natural fibers rather than the synthetics. Most of the synthetic materials involve not only a high energy input but also the use of petrochemicals as feedstocks. This proposal is intriguing because of its large conservation potential. If it could be carried out it might make a significant impact on energy requirements. However, the problems of controlling public taste and preferences in a free society are baffling in their difficulty.

There may be some change in public preferences as native supplies of oil and gas decline and prices increase for goods with a large energy input, but this is not certain. Untortunately, all the attractions of novelty, and the forces of promotion, work in the other direction, to create expanding markets for aluminum, for other electrometallurgical products, and for the new synthetic materials of petrochemical origin which are issuing in a constant stream from the laboratories and factories of the great chemical companies of the world.

Perhaps the most serious objection to the proposal to use ma-

terials with low energy inputs is the implicit assumption that energy is the limiting factor in production. Many scientists believe to the contrary that society will increasingly need to use energy for the very purpose of providing synthetic substitutes for scarce natural materials. Their case would be clearer if the synthetics were an outgrowth of shortages; however, many originate in commercial opportunities having little relation to availability of supplies of natural materials. Nevertheless, inhibiting the development of synthetics carries a social cost of its own which should be balanced against the direct energy savings. For example, large additional land areas would be required for row crops and pastures, and a great deal more artificial fertilizer and manpower would be needed for cultivation, if we were to revert to cotton, wool, linen and silk for all our fabric needs.

I turn now to possible ways to restrain demand which seem to me to have greater promise and in which potential savings would be significant both in terms of energy resources and in environmental protection. I do not limit myself to electricity, but cover the primary fuels as well.

A major share of energy requirements both in electricity and the primary fuels is devoted to climate control, that is, to the heating and cooling of buildings. Here is a prime candidate for energy savings. For a variety of reasons, it appears that perhaps half of the energy used for this purpose is wasted; at least, adequate climate control can be achieved with half the energy. One of the reasons is that in the past energy has been cheap and plentiful and no thought has been paid to ways of minimizing energy drain. To the extent that energy use was determined on the basis of a calculation by the owner or the architect-engineer as to relative costs of constructing and operating a building designed for low energy use, as compared with one of wasteful construction, the very low levels of energy costs in the past tended to encourage energy waste. The situation is aggravated by the fact that many buildings, both residential and commercial, are built by speculators who are far more interested in keeping initial construction costs down than in controlling the energy costs over the life of the building.

A special anomaly has been that, for the electric power industry to compete for space heating, better-insulated buildings were required. It may be that insulation standards for electrically heated buildings do not permit necessary ventilation for heating systems

involving combustion on the premises, but there is room for large improvement in standards for gas and oil-heated buildings.

Increases in fuel prices may lead automatically to better insulation, but I do not believe that in this situation we can depend upon market factors alone, if for no other reason than that the financial calculations of commercial builders place overwhelming importance on initial construction costs rather than on total costs over the long term.

The exposed glass and aluminum box with fixed windows has become the office building standard, despite the enormous amount of energy waste in heating and cooling in this type of construction. A couple of months ago, the New York Public Service Commission, with the cooperation of the State's Office of General Services, sponsored a workshop in Albany on energy conservation in public buildings. At the Albany Workshop there was much discussion of the use of heat absorbent glass, of heavy insulation, of natural ventilation, of shading and reflection, of avoidance of excessive lighting levels, and of many other possibilities for reducing energy requirements for both heating and cooling. These techniques could reduce total energy use by a substantial percentage. The Commission's engineers have calculated that if all buildings were insulated as well as the electrically heated buildings, the superior insulation alone would save roughly 40% of the energy used in new buildings. By 1980 the savings could amount to the equivalent of some 5 to 6% of national oil requirements, and there are many other possible improvements in building construction for reducing energy loads besides better insulation.

Administrative vehicles are available for imposing energy efficiency standards upon the building industry. State and municipal building codes could readily be adapted to this purpose. The regulatory framework already exists and one needs only to add to the regulatory matrix a concept of energy efficiency. It could well be that if the states and local governments do not take adequate action, the Federal government may be required to step in, but in either case the proposal involves no radical economic or political innovations.

There is much the Federal government can do without taking total control over construction standards. The Department of Housing and Urban Development has already begun to move in the direction of nationwide energy conservation standards. There

is far more that can be done by the construction and operating agencies of the Federal government. Similarly, the states could well set an example in their own construction and in the programs dependent upon State aid. In New York there has been a beginning in this direction. The state agencies responsible for building construction and operation are placing greater emphasis on energy conservation. A Fuels and Energy Committee, established by Governor Nelson A. Rockefeller, has been charged with developing programs for protecting the interests of fuel users of the State. As the chairman of this group, I am looking forward to the development of a comprehensive program to present to the Governor and the Legislature.

Perhaps the greatest potential for savings is in transportation uses of energy. It is hard to see the social necessity for locomotive-size vehicles of several hundred horsepower, many of them carrying only a single passenger. The gas mileage of all motor vehicles has actually declined from year to year, from 13.80 miles per gallon in 1940 to 12.15 in 1969, and for passenger cars from 15.29 miles per gallon in 1940 to 13.75 in 1969. Many automobiles do twice as well in gas mileage, and provide excellent transportation. A doubling of the gas mileage of passenger vehicles alone would save 3.5 million barrels of oil a day at the projected 1985 level of consumption, which amounts to 38% of national gasoline requirements or about a sixth of total petroleum needs. The saving could be accomplished either by using more economical propulsion systems than the internal combustion engine or by imposing size and efficiency limits on such engines, in either case without any drastic impact on the convenience of American motorists or of the Aerican economy. A transition to less wasteful passenger vehicles would by no means eliminate the growth of the petroleum industry or result in the demise of the automobile industry, but would only slow the pace of growth.

Restraining the demand for gasoline and other automotive fuels requires a measure of social innovation. One possibility is to impose such heavy taxes on automobile engines above, say, 75 horsepower per passenger vehicle, as to channel demand to vehicles with low horsepower. The trouble with the tax approach is that it would extend and deepen class divisions within the American society, and could be only partially effective. The rich would continue to be able to buy 300 or 400 horsepower vehicles, while the freedom of choice of families in modest circumstances would be

severely restricted. To make automotive horsepower a badge of wealth would produce unfortunate social side effects.

A similar objection applies to reduction of motor fuel consumption by imposing high additional taxes on gasoline and other motor fuels. With gasoline at $1 a gallon, let us say, undoubtedly there would be a good deal less driving, and there would be greater incentive to buy cars of low horsepower and high engine efficiency or to use mass transportation, but these incentives would not apply to the rich. I do not believe that the entire burden of environmental protection should fall upon those of small or modest means. It will probably always be more comfortable to be rich rather than poor, but it seems to me that whatever devices are used to discourage energy consumption should apply as nearly as possible to everyone.

An alternative which would operate with less unfairness would be a Federal proscription of high horsepower vehicles, with limited exceptions for police, ambulance and similar public purposes. A limit by horsepower or by the size of the engine could result in a competition for excellence within the prescribed limitations rather than the current race to attract customers by the size and wastefulness of the automobile engine.

This proposal, I recognize, involves a limitation on consumer choice which will not sit well with many Americans, and I do not expect that it will be adopted in the current Congress. Nevertheless, as this nation confronts more and more the implications of the current energy shortage and of the national dependence on oil imports, not to mention the environmental impacts resulting from the enormous growth in the automobile population and horsepower, I believe we will eventually come to this or some similar solution. There is already a considerable body of thoughtful people who are prepared to move in this direction, and their numbers will grow with time.

I should also mention the role of the electric car in the solution to the problem of extravagant use of imported motor fuel. Automotive prime movers accounted in 1970 for about 95% of the total of all prime movers, compared to 2% for electric generating plants; 19.3 billion horsepower was used by automotive prime movers compared with less than 0.5 billion horsepower for generating plants. Complete electrification of motor vehicles would add only some 40 percent to electric consumption and would represent a saving in prime mover capacity on the order of 100 to 1. The air

pollution load would be reduced from 115 million tons to 39 million tons even at present levels of electric generating plant efficiency, a reduction of 76 million tons or about two-thirds. Considering performance problems, I do not expect a total conversion; but the combined benefits of energy conservation, reduced dependence on imports, and reduction of air pollution, provide such commanding social inducements that the electric car will almost certainly have its day, and all the sooner if there is a breakthrough in any of the several research efforts now under way to develop a substitute for the lead acid battery which will make possible automobile performance comparable with that of a conventionally-powered car.

It is noteworthy that, while the automobile industry sends out into the country every 10 days about as much prime mover capacity as the power industry adds in a year, the environmental opposition has delayed power system expansion in recent years. This has added heavily to power service costs, but has not affected automobile output.

Finally, a great area of potential economy lies in setting standards of efficiency for energy utilization equipment. Some air conditioners, for example, are more than twice as efficient as others in the use of electricity. However, few buyers are made aware of the differences in energy efficiency, and the customers' choice will usually depend upon small differences in first cost, or upon appearance or convenience features. Here, too, is a potential for saving a significant portion of the nation's fuel bills with commensurate improvement in the rate at which we are exhausting our fossil fuel resources.

It seems to me that there is little justification for the deliberate degrading of electrical equipment by manufacturers in order to secure a small competitive cost advantage. There is already a considerable degree of standardization of equipment performance for safety purposes. I believe that society has an equal stake in the avoidance of the waste of a common pool of energy resources, and that the exercise of government powers is justified to require that energy-using equipment meet reasonable standards of efficiency. The production and sale of inefficient equipment is frequently a fraud on the consumer, and such legislation could well be justified on consumer protection as well as energy conservation grounds.

Energy conservation can only be one facet of a national strategy to cope with the nation's energy problems, present and future.

While we try to dampen the rate of growth, we must also work to augment and safeguard our supplies. Almost above every other element must come a far more intensive research program, including the nuclear area, conventional power sources, and the sources still in the exotic stage. No one should dismiss the dream of energy sources so cheap and plentiful, and so free of adverse environmental effects, that they can liberate man from the danger of want. It is in working to fulfill this dream that scientists and engineers can make one of their most important contributions to history.

FOOTNOTES

* Chairman, New York State Public Service Commission. This article is adapted from a talk given at the Energy Seminar Program, Oak Ridge, Tennessee, on April 6, 1972.